Precious Metals Moving Toward the Third Millenium

Highlights of the 22nd IPMI Technical Conference, Toronto, Canada, June 14-17, 1998

The meeting consisted of seven technical sessions, entitled 'Separation and Analysis', Finance and Economics', 'Gold', 'Precious Metals in Fuel Cells and their Fuels', 'Environmental, Health and Safety', 'Catalysis and Technology', and 'Environmental Interactive Forum'. Papers dealing principally with various aspects of gold science and technology were presented in three of these sessions and the highlights of these papers are summarized below.

This conference was attended by over 200 delegates from 16 countries and was opened by an informative and challenging talk from Dr Mike Steel, Johnson Matthey Marketing, London, UK, who forecast that, based on extrapolations of current demands for palladium, there is likely to be a significant shortfall in world supplies of this metal by the year 2002. Increasing demands in the autocatalyst, electronics, dental and other areas is unlikely to be met by supplies from the principal sources, *ie* Russia, South Africa and Canada. Since there is a history of difficulties of this kind experienced by the precious metals industry being met by increasing use of other precious metals, this present reviewer is asking "Will some of this demand be met by increasing the use of gold". For example, investigations into the use of gold catalysts in reactions significant in air pollution control may lead to some appropriate technical solutions. A wider use of gold could result from increased research activity on the properties of gold and its derivatives in catalysis and in other areas such as the medical and electronics fields

1 Separation and Analysis

1.1 Alessandra Marucco (CNR - TEMPE, Istituto per la Tecnologia dei Materiali e dei Processi Energetici, Milano, Italy) presented an account of work carried out in collaboration with Wieslaw Stankiewicz (IMN, Institute of Non-Ferrous Metals, Gliwice, Poland) on 'X-ray Fluorescence Spectrometry as an Alternative to Cupellation for Gold Determination in Gold Jewellery Alloys' (see *Gold Technology* and forthcoming article in *Gold Bulletin*). The chemical compositions of 27 ternary Au-Ag-Cu alloys and quaternary Au-Ag-Cu-Zn or Pd alloys were determined by XRF spectrometry by developing a mathematical method for the correction of the matrix effects for the analysis of Au, Ag, Cu, Zn, Pd and Ni. Sixteen certified gold reference materials were used, and the quality of this approach for accurate analysis was compared with results obtained by cupellation, ICP and SRF spectrometry, as well as XRF spectrometry using empirical curves. This new approach produced accuracies for the gold determination which were only slightly lower than those obtained by cupellation and the accuracies for the determination of minor elements were similar for both methods. The XRF method only takes about two minutes and gives results for all the impurities and alloying elements simultaneously, allowing the certification of the entire alloy composition. The method is likely to prove advantageous in selected cases for the determination of gold in gold alloys to an accuracy of one part in a thousand.

The sixteen gold standards employed in this work are available commercially (see *Gold Bulletin*, 1996, **29**, 74).

1.2 'Solvent Extraction of Gold Cyanide with Tributylphosphate and Additive added in the Aqueous Phase' was the title of a presentation by Chen Ting (Institute of Precious Metals, Kunming, China). The new solvent extraction system for $Au(CN)_2^-$ operates over a much wider pH range (2 - 12) than was the case for systems developed previously. Using tributylphosphate, and a gold cyanide : surfactant ratio of 1:1, $Au(CN)_2^-$ could be quantitatively and selectively extracted from both synthetic and mined samples in gold concentration ranges from 0.05 - 5 g/l, and the time required was short.

2 Gold

2.1 This session opened with a stimulating talk by Vanessa Motto (CPM Group, New York, USA)

entitled 'The Outlook for Gold Mine Output and Factors Determining Gold Production'. Gold production from mines has risen sharply worldwide over the past 16 years and amounts to the biggest gold rush in history! The geographical pattern for production is changing, however, with significant contributions in recent years coming from the US and Australia. The economics of production is dictated by a balance between price and cost as well as by the legal and environmental regulations, the technology available, and the resources. There are strong influences on cost caused by the investment climate but as the new Euro currency and the Asian financial situation become more secure, the price of gold should recover. This reviewer comments that significant new uses for gold would also affect the price, and that developments of recent results from research involving systems containing gold could lead to such developments.

2.2 Francois Corderre (University of British Columbia) presented a paper written in collaboration with David Dixon describing 'Modelling the Cyanidation Heap Leaching of Cupiferous Gold Ores'. The mathematical model developed was a modification of that previously developed by Dixon and Hendrix, and this new model was validated by column testing of an Australian cupiferous low-grade gold ore containing approximately 0.35% Cu, mainly as copper sulfides, and 0.6 g/t gold.

2.3 Dr Adalbert Prior (Prior Technology AG, Zurich, Switzerland) described new designs of electrochemical cells which enabled more efficient recovery of both silver and gold. Using these cells, both silver flake products and anode slimes were collected continuously and automatically on a 24hr basis. The Au/Ag ratio in the gold collected was 10:1 compared with 2:1 for cells in general use.

2.4 'Diagnostic Leaching of Gold and Copper Ores' was the title of a talk given by Dr Corby Anderson (CAMP - Montana Tech, Butte, USA). This approach is designed to give better mineralogical definition to difficult ore bodies. The metallurgical treatment options can then be developed more efficiently. This approach can also be used for troubleshooting in existing processes. Some companies are beginning to use this technique, and it could be used more generally.

2.5 Professor Xinzhe Lan Xian (University of Metallurgy and Construction Engineering, Shaanxi, China) reported the work that his group has been doing in collaboration with Zhihao Jin (Xian Jiaotong University, Xian, Shaanxi, China). Developments in the patented MLSSS gold leaching process using polysulfide, elemental sulfur, and thiosulfate ions as well as copper ammonium ions and other species were described. This is an improvement on the LSSS process reported to IPMI - the speed of gold dissolution has been increased by 50% and less reagent is required.

3 Catalysis and Technology

3.1 A talk entitled 'New Advances in Gold Catalysis' was presented by David Thompson (*Gold Bulletin*, Reading, England). It was pointed out that as for many aspects of gold science and technology, gold catalysis has unique features. Until recently, gold catalysis has had an uncertain history, but research work in a number of laboratories has now shown that if care is taken in the preparation of well-defined supported gold catalyst systems then these systems can be unusually active and/or selective for a number of reactions of commercial importance. These include such reactions as oxidation of carbon monoxide and hydrocarbons, hydrochlorination and hydrogenation. In fact, gold has been demonstrated to be the element of choice in some reactions. As a result, both chemical processing and environmental applications are foreseen for supported gold catalyst systems. The current knowledge on supported gold catalyst systems was reviewed and the importance of some recently reported early examples of homogeneous gold catalysis, in solution, assessed.

3.2 Dr David Lupton, Heraeus, Germany, gave a talk entitled 'Dispersion Hardened Platinum and Platinum Alloys for Very High Temperature Applications'. The strength of Pt-5% Au oxide dispersion hardened (DPH) alloy is considerably higher at 1600°C than that of the conventional Pt/20% Rh alloy at 1400°C. Moreover, the rupture strength of the gold-containing alloy is maintained over considerably longer test times, i.e. the strength advantage increases not only with temperature but also with time.

David Thompson